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Introduction to Cerebral Angiography

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18 INTRODUCTION TO CEREBRAL ANGIOGRAPHY

withdrawn, then 3 to 5 ml are flushed forward. The stopcock is turned off just before the flush is terminated. This leaves the catheter filled with heparinized solution. This is the so-called double flush technique and should be used meticulously throughout the procedure. The catheter is flushed approximately every 90 to 120 seconds during the angiogram.

Once the catheter has been inserted and properly flushed, one of the syringes is filled with contrast. (The syringes should not be filled with contrast until they are ready to be used. Prolonged waiting may allow contrast to crystallize along the barrel and "freeze" the syringe.) The syringe is attached to the catheter and the plunger withdrawn until all air in the system is removed and a small amount of blood is also withdrawn. With the nose of the syringe pointing downward, under fluoroscopy, a small amount of contrast is injected through the catheter to make certain it is within the aortic lumen.

Still under fluoroscopy, the catheter is advanced over the aortic arch and gently rotated until the tip of the primary curve points cranially. By advancing or withdrawing the catheter the brachiocephalic vessel orifices can be engaged. A small test injection following an appropriate double flush will confirm the location of the catheter tip. At this point, the patient should be reminded what sensations to expect: a feeling of warmth in the face, metallic taste, and so forth, depending on which vessel has been catheterized.

If the catheter tip is in the desired vessel, the guidewire is passed through it (*flexible tip first!*) and advanced into the artery. The catheter can then be advanced over the wire and the wire removed. Again, the catheter is double flushed. If no clots are present, a small test injection of contrast may be made to verify the catheter position.

Once the appropriate vessel is successfully catheterized, contrast is injected during a filming sequence. Hand injections of contrast produce relatively poor intravascular opacification, expose the angiographer to unnecessary radiation, and may be difficult to time properly. Therefore, most institutions use a me-

chanical pressure injector both to keep the rate and volume of contrast injection constant and to provide proper timing with modern rapid sequence film changers.

The injector barrel and connecting tubing should be checked to make certain all air bubbles are expelled.

As soon as the technician has positioned the patient, the catheter is flushed once more and, with the stopcock open, attached to the connecting tubing. The technician slowly backs up fluid from the tubing until the blood-fluid interface is clearly seen. If no air bubbles are present, 1 or 2 ml of contrast medium are flushed forward through the catheter. The injector syringe should be pointed down and arranged so that no kinks or curves are present in the catheter. The volume and rate of injection as well as injector delay are selected. (If biplane films are to be obtained a delay of about 0.2 seconds is usually necessary. This insures a non-contrast film that can be used later to make a subtraction mask.) Typical contrast volumes are 10 ml at 8 ml/second for common carotid injections, 8 ml at 7 ml/second for internal carotid studies, and 6 or 7 ml at 5 or 6 ml/second for vertebral artery injections. The volumes and injection rates vary considerably with the size of the catheterized vessel as well as the intracranial flow and should be adjusted accordingly.

The mechanical volume stop on the injector is set, the patient's position quickly checked, all injector settings rechecked, and the catheter stopcock opened. The film programming sequencing and technique settings are quickly checked. The patient is reminded of the sensations and temporary discomfort he is likely to experience. His cooperation in remaining perfectly immobile during the run is again requested.

After the film sequence is completed, the stopcock is closed and the injector is disconnected. The patient's neurological status is quickly assessed. It is usually advisable to withdraw the catheter from the injected vessel and position it in a safe place in the thoracic aorta until the films are checked.

This procedure is repeated until all the req-

site vessels have been studied. After the study is completed, the catheter should be removed and manual pressure applied to the site. (The meticulous angiographer rather than delegating this task to the technician.) The location should be inspected for hematoma and peripheral pulses rechecked. A follow-up visit late

Precautions

A few precautions should be observed: Do not advance the guidewire to pass the origin or common carotid arteries until you have ruled out plaques with either Doppler or ultrasound. Do not advance the guidewire protruding beyond the catheter tip.

DIRECT PUNCTURE

With the advent of angiographic techniques, visualizing the vertebral arteries by direct puncture has diminished. Nevertheless, this technique is still used in certain patients with occlusive vascular disease of the great vessels, or for certain procedures.

The patient is placed in a lateral position with the shoulders perextended. The pulsation of the common carotid artery is determined with 1% lidocaine infiltration of the skin. Infiltration of the tissues is carried down to the common carotid artery with a 22-gauge needle. ^{24A}

A variety of various stabilizers

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